OPTO-ACOUSTIC METHOD OF TISSUE OXYGANATION AND ITS APPLICATION IN CANCER THERAPY

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In this report result of experimental investigation the efficiency of tissue oxygenation under combined effect of optical radiation and acoustic waives are presented. Practical application of new non invasive opto-acoustic method in modern biology and medicine, in particular, dermatology and oncology is discussed.

Optical method is based on application the phenomenon of laser-induced photodissociation of oxyhemoglobin in cutaneous blood vessels and capillaries [1]. This method allows extracting an additional amount of oxygen from blood oxyhemoglobin directly at the zone of irradiation. Application of acoustic method enhances the efficiency of optical method due to significant improvement of local blood microcirculation. In fig. 1 illustration of tissue oxygenation with optical radiation and acoustic waves is presented.

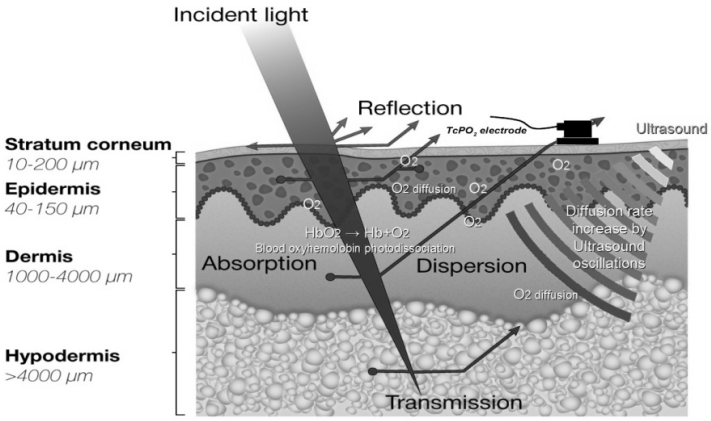

Fig. 1. Illustration of tissue oxygenation with optical and acoustic methods

The optical effect of laser-induced tissue oxygenation could be enhanced by applying the method of acoustic vibrations – ultrasound. It enhances blood microcirculation and in combination with the method of laser-induced tissue oxygenation the concentration of oxygen significantly increases. Experimental investigation of new opto-acoustic method of tissue oxygenation for restoring normal cell metabolism is presented in fig.2.

Fig. 2. Experimental measurements the effect of combined opto-acoustic method on the level of tissue oxygenation

The value of oxygen concentration usually is controlled by the method of transcutaneous oximetry. This method is based on direct measuring oxygen tension PO_2 in skin tissue.

Experimental measurements the effect of acoustic waves was carried out under at the amplitude of 1 to 5 volts and a frequency from 30 to 90 kHz. The exposure time of the acoustic waves ranged from several seconds up to few minutes. The results of the measurements show the influence of ultrasound, improves blood circulation about 12% that increases the degree of tissue oxygenation.

Thus, novel opto-acoustic method allows eliminate the deficit of oxygen until a new blood vascular net is formed. This result could be applied for those pathologies where elimination of tissue hypoxia is critical [3]. For example, hypoxia in cancer tissues that occurs due to the fast growth of cancer cells and disordering blood microcirculation. Therefore improving the oxygenation of solid tumor masses in order to eliminate hypoxia is the one of actual problems in modern oncology.

The obtained results show that combined opto-acoustic method of tissue oxygenation allows two times increase local oxygen concentration.

Thus, application of developing method can significantly improve the efficiency of therapeutic methods such as photodynamic, radio and chemotherapy of solid tumors. At the same time this method reduces unavoidable negative effect on normal cells surrounding tumor masses.

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